BAYOU TECHE TMDL FOR SALINITY/TOTAL DISSOLVED SOLIDS

SUBSEGMENT 060301 (inclusive of subsegment 060205)

US EPA Region 6

Final

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TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. A TMDL has been developed for salinity/total dissolved solids (TDS) for Bayou Teche. Throughout the rest of this document, the term TDS will be used to signify also salinity.

Bayou Teche flows from its headwaters in South Central Louisiana to Charenton Drainage Canal and Lower Bayou Teche. Subsegment 060301 (inclusive of subsegment 060205) was listed on the Court Ordered §303(d) list as not fully supporting the water quality standard for propagation of fish and wildlife and was ranked as a high priority for TMDL development. This TMDL addresses this listing. Louisiana's water quality standards for chloride, sulfate, and TDS are applied as follows:

> "Numerical criteria for these parameters generally represent the arithmetic mean of existing data from the nearest sampling location plus three standard deviations. For estuarine and coastal marine waters subsegments in Table 3 that have no listed criteria (i.e., designated N/A), criteria will be established on a case-by-case basis using field determination of ambient conditions and the designated uses. For water bodies not specifically listed in the Numerical Criteria and Designated Table, increases over background levels of chloride, sulfate, and TDS may be permitted. Such increases will be permitted at the discretion of the office on a case-by-case basis and shall not cause in-stream concentrations to exceed 250, 250, and 500 mg/l for chloride, sulfate, and TDS, respectively, except where a use attainability analysis indicates that higher levels will not affect the designated uses. In permitting such increases, the office shall consider their potential effects on resident biota and downstream water bodies in addition to the background conditions. Under no circumstances shall an allowed increase over background conditions cause any numerical criteria to be exceeded in any listed water body or any other general or numerical criteria to be exceeded in either listed or unlisted water bodies."

Seven months (June, 1998 – December, 1998) of monthly LDEQ monitoring data on Bayou Teche (water quality site 0673) were assessed to determine if the propagation of fish and wildlife use was being maintained. Analysis of the data shows that the propagation of fish and wildlife use is not protected. TDS data were not available at WQ site 0673 and were therefore estimated using conductivity data. TDS can be estimated by multiplying conductivity values by a multiplier. For the analyses of natural waters, the multiplier ranges between 0.55 and 0.96, the higher values generally being associated with waters high in sulfates (Hem, 1985, p. 67). For this data set, 1.09 was calculated as a multiplier using conductivity and TDS data from an upstream station (WQ site 0031). Using this multiplier to calculate TDS at WQ site 0673, it was determined that ninety-two percent of the measurements at WQ site 0673 exceeded the TDS criterion of 220 mg/l (see Appendix A). Therefore, a TMDL was developed to protect the propagation of fish and wildlife use.

For the purpose of TMDL development, the criterion of 220 mg/L was applied. The TDS TMDL was developed based on simple dilution calculations using average flow and the State's TDS criterion of 220 mg/L for this subsegment. The TMDL calculation includes a wasteload

allocation, a load allocation, and a margin of safety. A 47.2% reduction in TDS loading will be needed to meet the standard for the propagation of fish and wildlife use.

1. Introduction

Bayou Teche, subsegment 060301 (inclusive of subsegment 060205), was listed on the October 28, 1999 Court Ordered §303(d) list as not fully supporting the water quality standard for the propagation of fish and wildlife use and was ranked as a high priority for TMDL development. A TMDL for total dissolved solids (TDS) was developed in accordance with the requirements of Section 303(d) of the federal Clean Water Act. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources for the pollutant of concern and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

2. Study Area Description

2.1 Bayou Teche, Subsegment 060301

Bayou Teche flows through the Vermilion-Teche River Basin in South Central Louisiana. Subsegment 060301 (inclusive of the former subsegment 060205) runs from the headwaters at Bayou Courtableau to Keystone Locks and Dam. The Vermilion-Teche River Basin lies in the Western Gulf Coastal Plain ecoregion. The watershed is characterized as plains/prairie, and the land is generally flat with a very gradual slope toward the Gulf of Mexico. The major land uses are listed in Table 1 (LDEQ 1993).

Table 1. Land Use for segment 0603 of the Vermilion-Teche River Basin

Land Use Type	Number of Acres	% of Total Area
Urban	186	35.3
Extractive	47	8.9
Agricultural	294	55.8
Forest	0	0
Water	0	0
Wetland	0	0
Barren Land	0	0
TOTAL AREA	527	100.0

2.2 Water Quality Standards

The designated uses for Bayou Teche include primary and secondary contact recreation and the propagation of fish and wildlife. TDS is a water quality indicator used for assessment of use support. Louisiana's water quality criterion for TDS is 220 mg/L (Subsegment 060301).

2.3 Identification of Sources

The sources identified in the *1998 Louisiana Water Quality Inventory* as affecting the water quality of Bayou Teche are designated as irrigated/non-irrigated crop production and minor industrial point sources (LDEQ 1998).

2.3.1 Point Sources

There are 16 permitted facilities (with known flow information) discharging sanitary wastewater into Subsegment 060301. The combined flow of all these discharges is 6,157,390 gallons per day (see Table 2) (Carney, 2000).

Table 2. Dischargers in Subsegment 060301

Facility	Permit	Flow (MGD)	Load (lb/day)*
LA Sugar Cane Coop Inc.	LA0000787	0.18	330.26
Dallas Trailer Park	LAG530160	0.0024	4.40
Acadiana Treatment System Inc.	LAG530027	0.003	5.50
St. Martin Parish School Board	LAG540696	0.009015	16.54
St. Landry Parish School Board	LAG540689	0.007875	14.45
CBS Enterprises, CBS MHP	LAG540226	0.0156	28.62
St. Landry Parish Sewer District #1	LA0057401	0.048	88.07
Town of Port Barre WWTP	LA0020419	0.5	917.40
Stelly Construction Inc.	LA0105562	0.0002	0.37
Charles G. Lawson Trucking Inc.	LA0109151	0.0035	6.42
Savoie's Sausage and Food Production	LA0095184	0.013	23.85
Koch Gateway Pipeline Co. – Opelousas Comp Stn	LA0108839	0.0031	5.69
St. Martin Police Jury and Others	LA0043991	3.0	5504.40
Bent Oak Trailer Park	LAG540911	0.0177	32.48
LA Sugar Coop., Inc.	LA0004375	0.864	1585.27
City of St. Martinville	LA0040941	1.49	2733.85
		Total Load:	11297.57

*load calculated using design flow and 220mg/L TDS criterion

2.3.2 Nonpoint Sources

The predominant land uses in the area of Bayou Teche are agriculture and forestry, and to a lesser extent, urban uses. It is presently unknown to what relative extent these sources contribute to TDS loads through runoff.

3. TMDL Load Calculations

3.1 Current Load Evaluation

TDS loads have been calculated using the instream TDS concentration and the flow of the stream. The following equation can be used to calculate TDS loads.

Equation 1. C x Q in cfs x 5.39 or C x Q in MGD x 8.34

Where: C = concentration in mg/L
Q = stream flow in cfs or MGD

A traditional expression of the loading may be developed by setting one critical or representative flow and concentration, and calculating the TDS load using Equation 1. The difficulty with this approach is in the determination of the appropriate flow or concentration value to use.

For the purpose of calculating current loading on this waterbody, the average TDS concentration was calculated using monthly LDEQ monitoring data on Bayou Teche (WQ site 0673). WQ site 0673 was used because it is located at the most downstream portion of subsegment 060301 and is considered most representative of this subsegment. However, TDS data were not available at this station and were therefore estimated using conductivity data. TDS can be estimated by multiplying conductivity values by a multiplier.

For the analyses of natural waters, the multiplier ranges between 0.55 and 0.96, the higher values generally being associated with waters high in sulfates (Hem, 1985, p. 67). In this TMDL, a multiplying factor was developed using the available field conductivity and TDS data from LDEQ water quality station 0031 on Bayou Teche (located upstream from WQ site 0673). The data available at this station is from June, 1958 through May, 1998. Since there were only seven months of data from WQ site 0673, the most recent year of sulfate and conductivity data from WQ site 0031 (1998) was used in an ANOVA to determine if the values were similar between stations (Appendix B). Since there was no statistically significant difference in sulfate concentrations ($p < 0.42$, $n=12$) or conductivity values ($p < 0.14$, $n=12$) between the two stations, the five most recent years of data (1994 – 1998) from station 0031 were used to calculate a multiplying factor. Dividing TDS values (mg/l) by field conductivity values (μmhos) for each sampling date and then taking the average resulted in a multiplying factor of 1.09 mg/l/μmho. TDS was then estimated by multiplying the field conductivity data from WQ site 0673 on Bayou Teche (June, 1998 – December, 1998) by the multiplier (1.09 mg/l/μmho). The monthly estimated TDS concentrations ranged from 129 mg/L to 528 mg/L over the seven month period. The average TDS concentration was 417 mg/L (see Appendix A).

The average flow for Bayou Teche is 760 ft^3/sec (see Appendix C). Using these values and Equation 1 it is estimated that the current loading is 1,708,199 lb/day.

3.2 TMDL

Point sources usually have a defined critical receiving stream low flow such as the 7Q10 (or Harmonic mean flow) at which the criterion must be met. For nonpoint sources it is recognized that there may be no single critical flow condition. The load reduction needed to meet the water quality standard for propagation of fish and wildlife in Bayou Teche at 760 cfs is 806,991 lb/day (47.2% reduction). This was obtained by calculating the allowable TMDL at 760 cfs for the 220mg/L criterion (901,208 lb/day) and subtracting this load from the observed load (1,708,199 lb/day).

TMDL= Cstd x Q cfs x 5.39 lb/day, where Cstd= 220 mg/l, Q=760 cfs

TMDL= 220mg/l x 760cfs x 5.39 lb/day = 901,208 lb/day

Current Load - TMDL = Load Reduction

1,708,199 lb/day – 901,208 lb/day = 806,991 lb/day

3.3 Wasteload Allocation (WLA)

The Louisiana Water Quality Regulations require permitted point source discharges of treated sanitary wastewater to maintain an in-stream TDS concentration of 220 mg/L on this subsegment.

Equation 1 can be used to calculate the total point source load (wasteload allocation) utilizing a TDS concentration of 220 mg/L and the total volume of all the wastewater dischargers (6,157,390 gallons/day).

220 mg/L * Q in MGD * 8.34 = WLA

Where Q = Total volume of sanitary wastewater discharges into Bayou Teche

WLA for all dischargers = 11,298 lb/day

3.4 Load Allocation (LA)

The load allocation for a given flow can be calculated using Equation 1 and the following relationship:

(TMDL@ given flow and criterion) - (WLA) = LA

LA at an instream flow of 760 cfs = 889,910 lb/day

901,208 lb/day (TMDL@ 760 cfs) – 11,298 lb/day (WLA) = 889,910 lb/day

3.5 Seasonal Variation

Louisiana's water quality standard for TDS is 220 mg/L for January through December. Therefore, no seasonal TMDL for TDS was developed.

3.6 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration a margin of safety. EPA guidance allows for the use of implicit or explicit expressions of the margin of safety or both. When conservative assumptions are used in the development of the TMDL or conservative factors are used in the calculations, the margin of safety is implicit. When a percentage of the load is factored into the TMDL calculation as a margin of safety, the margin of safety is explicit. In this TMDL for TDS, conservative assumptions have been used and therefore, the margin of safety is implicit. These conservative assumptions are:

- Using average flows to calculate current loading to obtain load reduction.
- Treating TDS as a conservative pollutant, that is, a pollutant that does not degrade in the environment.
- Using the TDS water quality standard of 220mg/l rather than using site-specific criteria and seasonal variability factors.
- Using the design flow (where available) of the point source dischargers rather than actual average flow rates, which are typically much lower.
- Using a conservative multiplier to estimate TDS from conductivity.

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored

again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

Carney, Jay. 2000. *Bayou Teche Watershed TMDL for Dissolved Oxygen Including WLAs for Twenty-Two Facilities and Addressing Nutrients*, *Subsegments 060205, 060301, 060401, 060501.* Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

Hem, John D. 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition. United States Geological Survey Water-Supply Paper 2254. U.S. Government Printing Office

LDEQ. 1993. *State of Louisiana Water Quality Management Plan, Volume 6, Part A: Nonpoint Source Pollution Assessment Report*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge.

_____. 1998. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge.

APPENDIX A. TDS DATA.

Bayou Teche (WQ site 673)

http://www.deq.state.la.us/surveillance/wqdata/0673wqnf.txt

Date	Sulfate mg/l	Field Conductivity μmhos	Estimated TDS* mg/L
12/2/98	19.7	267	291
11/18/98	12.4	234	255
11/5/98	42.3	427	465
10/21/98	48.3	480	523
10/7/98	58.3	460	501
9/16/98	8.2	118	129
9/2/98	44.2	484	528
8/19/98	30.7	395	431
8/5/98	34.1	419	457
7/22/98	35.2	415	452
7/8/98	38.9	412	449
6/17/98	48.7	478	521

* estimated TDS by multiplying field conductivity by 1.09 mg/l/μmho.

n = 12

TDS criterion = 220 mg/L

Exceedance rate = 11/12 = 92%

Average concentration = 417 mg/L

APPENDIX B. ANALYSES OF VARIANCE (ANOVA)

Cond 1998 Sta 0673	Cond 1998 Sta 0031	
267	241	
234	95	
427	394	
480	420	
460	422	
118	96	
484	444	
395	385	
419	386	
415	386	
412	380	
478	446	
	299	
	96	
	73	
118	73	min
484	446	max
382.4	341.3	avg
115.1	126.2	std
12	15	count

Anova: Single Factor (Conductivity)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Sta 0673	12	4589	382.4166667	13243.90152
Sta 0031	15	4563	304.2	20613.74286

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	40785.6463	1	40785.6463	2.347914142	0.138008801	4.241698548
Within Groups	434275.3167	25	17371.01267			
Total	475060.963	26				

Appendix B. Continued

Sulfate 1998 Sta 0673	Sulfate 1998 Sta 0031	
19.7	21.5	
12.4	5.5	
42.3	43.4	
48.3	49.5	
58.3	53.0	
8.2	5.9	
44.2	46.2	
30.7	35.0	
34.1	35.8	
35.2	33.0	
38.9	36.7	
48.7	47.4	
	26.7	
	3.6	
	2.5	
8.2	2.5	min
58.3	53	max
35.1	34.4	avg
15.2	15.9	std
12	15	count

Anova: Single Factor (Sulfate)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Sta 0673	12	421	35.08333333	231.1778788
Sta 0031	15	446	29.71333333	320.1940952

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	192.246	1	192.246	0.684083833	0.416009097	4.241698548
Within Groups	7025.674	25	281.02696			
Total	7217.92	26				

APPENDIX C. FLOW INFORMATION

Bayou Teche at Breaux Bridge (DEQ 031) -- Based on the adjusted runoff for the USGS station on Bayou Teche at Arnaudville and a subtraction of the estimated average flow for Bayou Fusilier, the estimated average streamflow is 760 CFS. The May - October average flow is estimated to be about 76% of the annual average flow; the November - April average flow is estimated to be about 124 % of the annual average flow.